

The background of the slide is a composite image. It shows a dark, silhouetted tree standing on a grassy hill. To the left of the tree, a bright, glowing light source, possibly a sun or moon, creates a warm orange and yellow glow that fades into the dark blue of the night sky. The sky is filled with numerous stars of varying brightness. The overall composition suggests a connection between the ground (the tree) and the sky (space).

Rooted in Quality

Cultivating Reliability from the Ground Up

W. C. Davis | Safety & Mission Assurance | NASA Johnson Space Center

Houston, We Have a Problem



GAO

United States Government Accountability Office

Report to the Ranking Member,
Subcommittee on National Security,
Homeland Defense and Foreign Operations,
Committee on Oversight and Government
Reform, House of Representatives

June 2011

SPACE AND MISSILE DEFENSE ACQUISITIONS

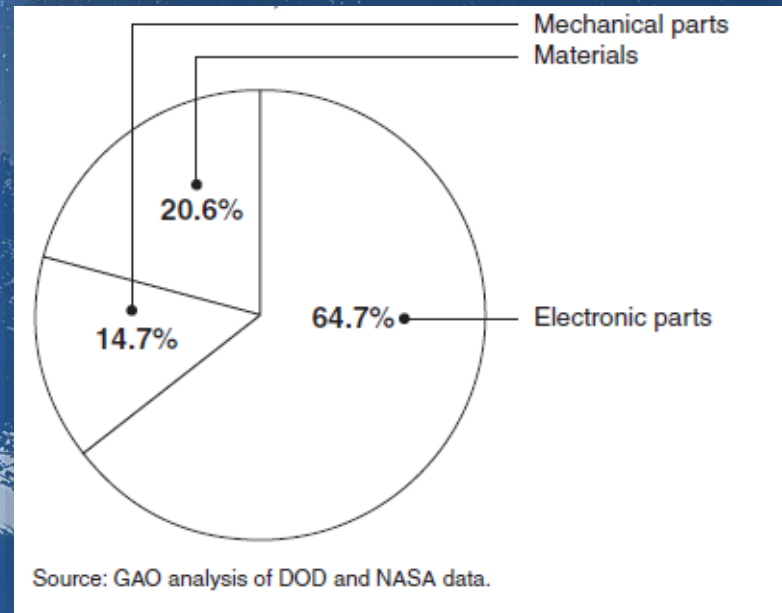
Periodic Assessment
Needed to Correct
Parts Quality
Problems in Major
Programs



GAO-11-404

Technology companies now face
supply chain they cannot trust

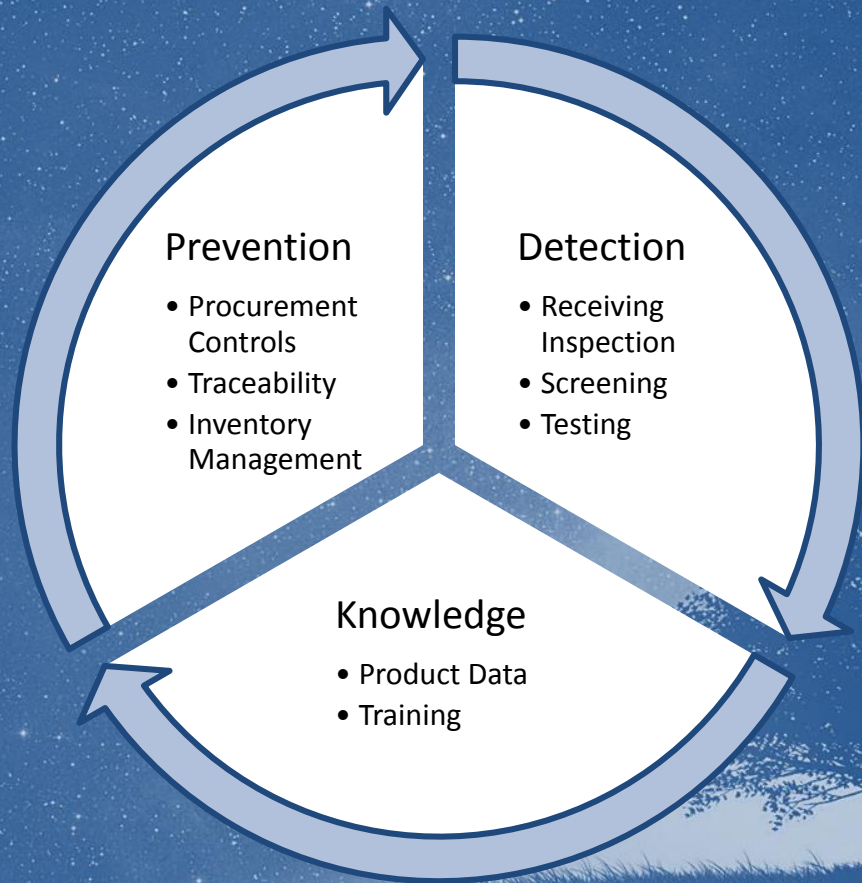
- Non-conforming Product
- Fraudulent Material
- Counterfeit Parts





Source: http://www.businessweek.com/magazine/content/08_41/b4103034193886.htm

Defining a Solution Space



- **Prevention**
 - Efforts to assure good parts/products are procured from reputable vendors
 - Most important aspect of product quality
- **Detection**
 - Efforts to verify authenticity of parts/products
 - Additional investigation (usually destructive) can be performed if discrepant characteristics are noted
- **Knowledge**
 - Efforts to share information on non-conforming product
 - Efforts to train employees on how to identify discrepant characteristics and/or suspicious attributes indicative of counterfeiting

Defining a Solution Space (cont.)



Supply Chain Evaluation

- Best: Original Component Manufacturers (OCM)
- Better: Franchised Distributors
- Good: Qualified Suppliers



Traceability

- Certificate of Conformance (CofC)
- Material Test Report (MTR)
- Purchase Orders



Quality Management System

- Industry Standards
- Quality Clauses
- Receiving Inspection Clauses

Procurement: Know what you're buying, who made it, and where it's been since it was manufactured

Defining a Solution Space (cont.)



Receiving Inspection

- Dimensional Inspection
- Documentation
- Visual Inspection



Non-Destructive Screening

- Chemical Analysis
- X-ray Radiography



Destructive Testing

- Decapsulation
- Electron Microscopy (SEM)
- Hardness Testing
- Tensile Testing

Screening: Verify the authenticity of what you bought and submit samples to spot check for irregularities

Defining a Solution Space (cont.)



Investigation Team

- Legal
- Quality
- Subject Matter Experts
- Test Laboratory



Additional Screening and Testing

- Destructive Testing (As needed)
- Non-destructive Testing (100%)

Investigation: Conduct in-depth investigation when irregularities are noted

Defining a Solution Space (cont.)



Notification

- GIDEP Notices
- NASA Advisory Documents



Knowledge Sharing

- GIDEP
- Lessons Learned
- NASA Supplier Assessment System (SAS)



Isolation

- Build Records
- Material Information Usage Lists (MIUL)
- Two-Way Traceability

Notification: Share product data on a need-to-know basis until wider distribution is authorized

Product Control



- Before you Purchase
 - Establish a process to evaluate, qualify, and monitor suppliers to assess ongoing risk level
 - Pre-determine testing procedures for individual product lines with defined sampling rates and acceptance criteria
- When you Purchase
 - Require documentation including Material Test Reports (MTRs) and purchase records to recreate chain of custody
 - Require all documents be in English
 - Evaluate traceability to determine testing at receiving inspection
 - Require higher level of sampling for un-qualified suppliers
 - Require higher level of sampling for lots with incomplete traceability
 - Communicate requirements to supplier and receiving organization

Product Control

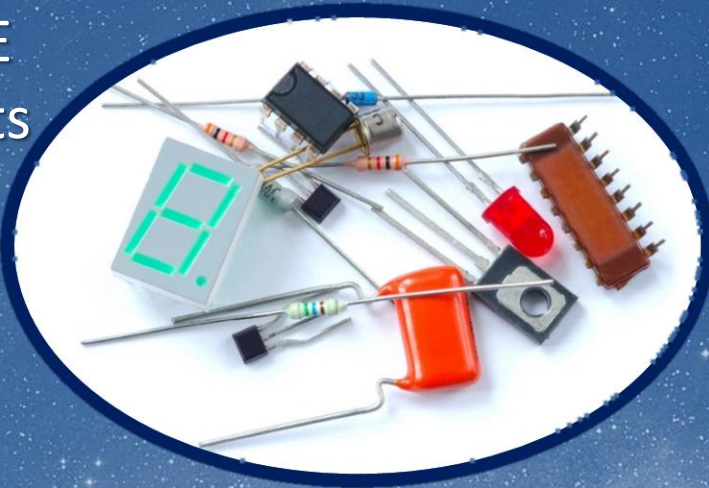


- When you Receive
 - Segregate inbound product until evaluated and cleared for use
 - Review and compare documentation and physical product/packaging for data inconsistencies (e.g. part number, etc.)
 - Randomly sample lot and submit samples for testing
- When you Test
 - Verify compliance to original procurement specification
 - Involve subject matter experts for questions
 - Report results and archive with procurement documentation
- When you Catch Something
 - Share you knowledge internally and externally, it could save a life!

Product Lines



EEE
Parts



Fasteners & Mechanical Parts



Gases



Raw Materials

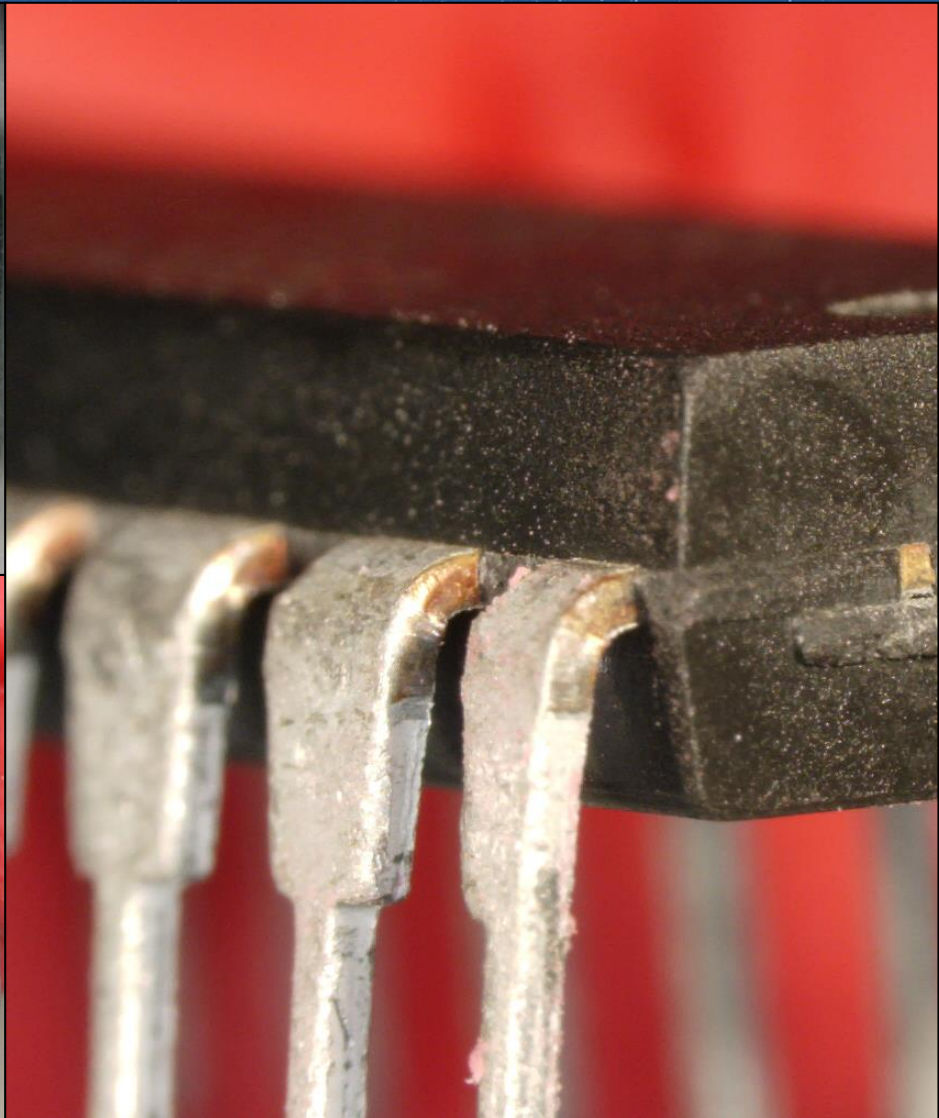
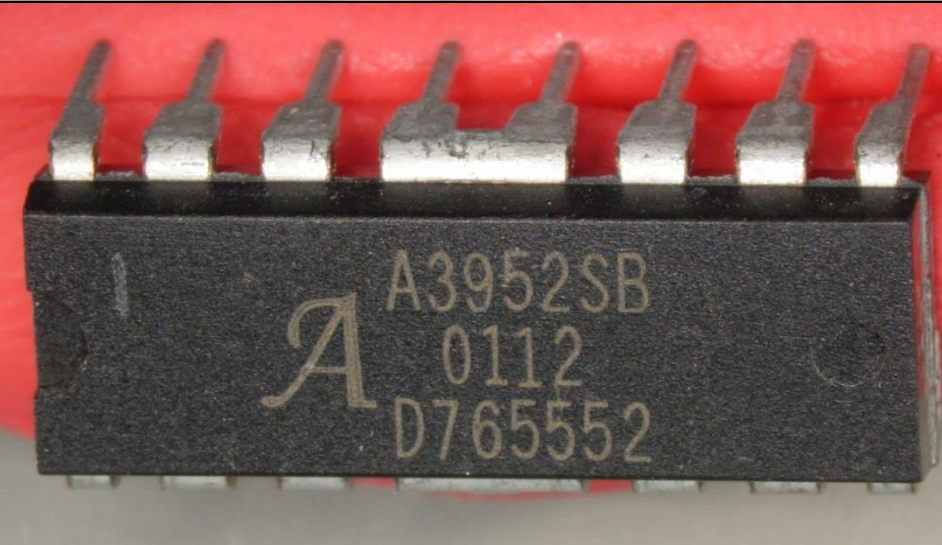
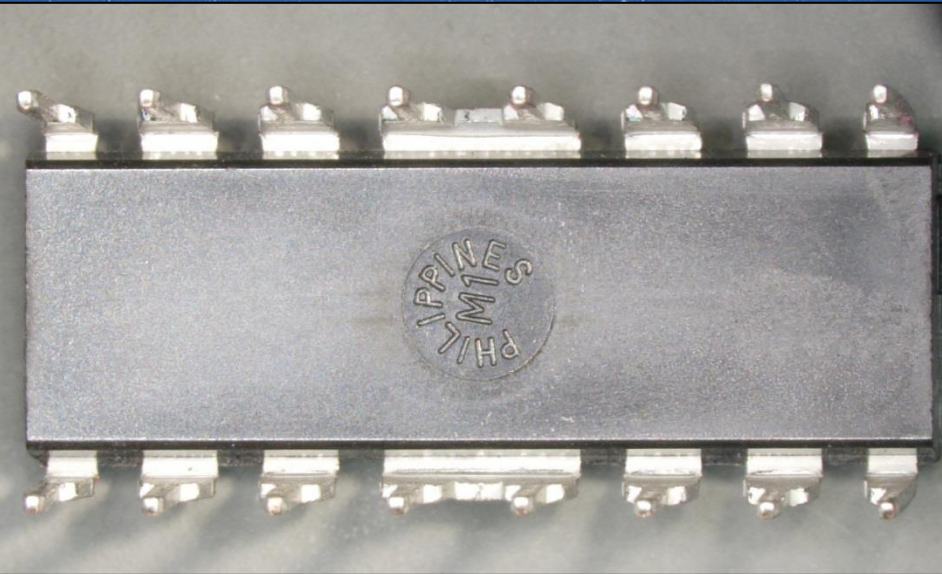


Product Lines – EEE Parts

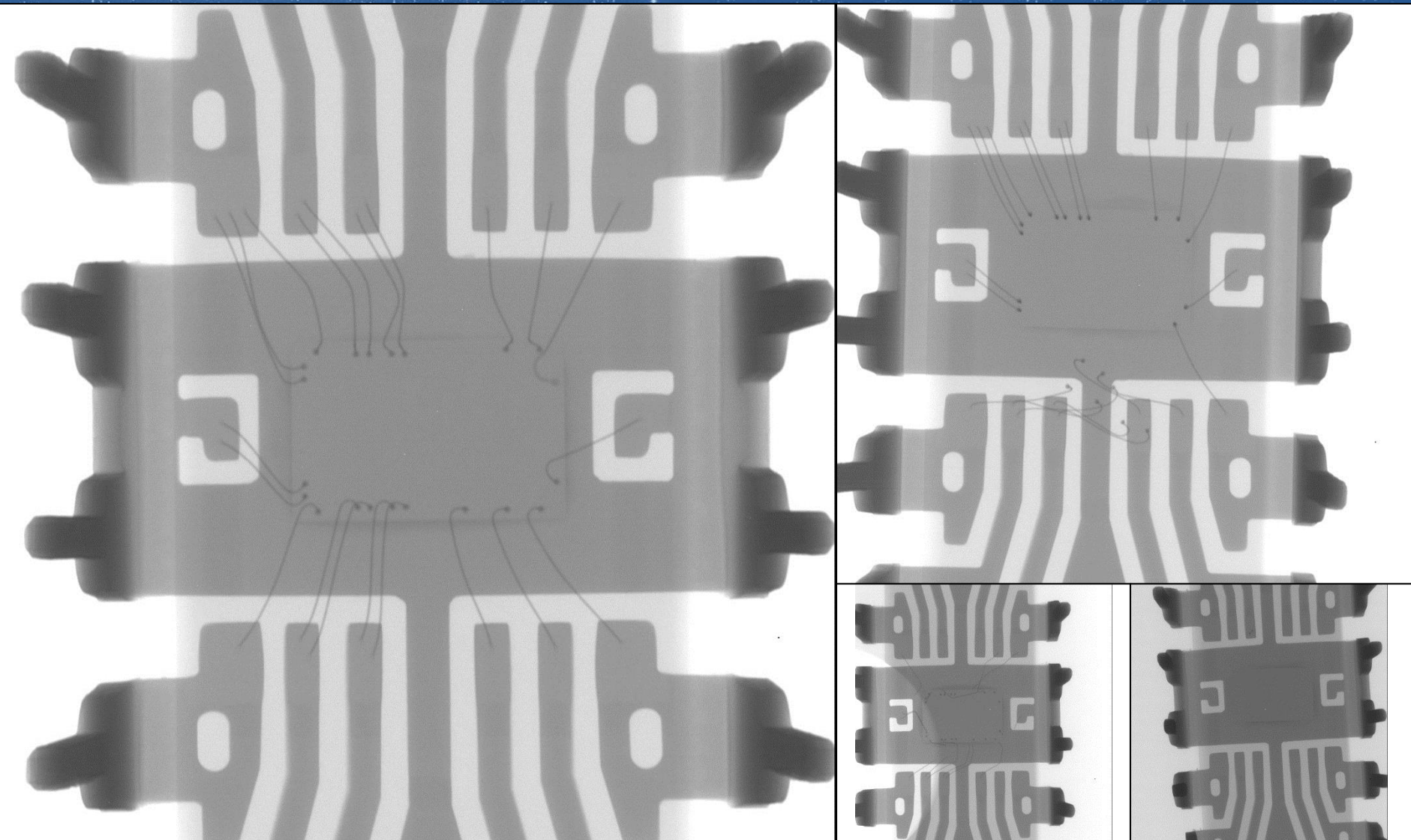


- Qualification of supplier only allowed when parts are procured from Original Component Manufacturer (OCM) or franchised distributor
- Documentation review for all procurements
- Validation testing required for non-qualified suppliers
 - Procurement reviewed by EEE Parts Control Board to determine what testing is appropriate
 - Lot subject to inspection for damage
 - Non-destructive evaluation performed when appropriate
 - Destructive Physical Analysis (DPA) on samples when appropriate

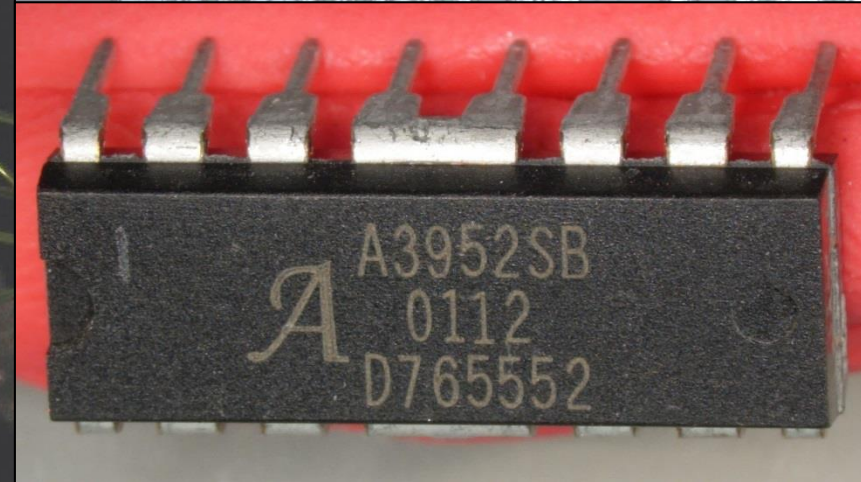
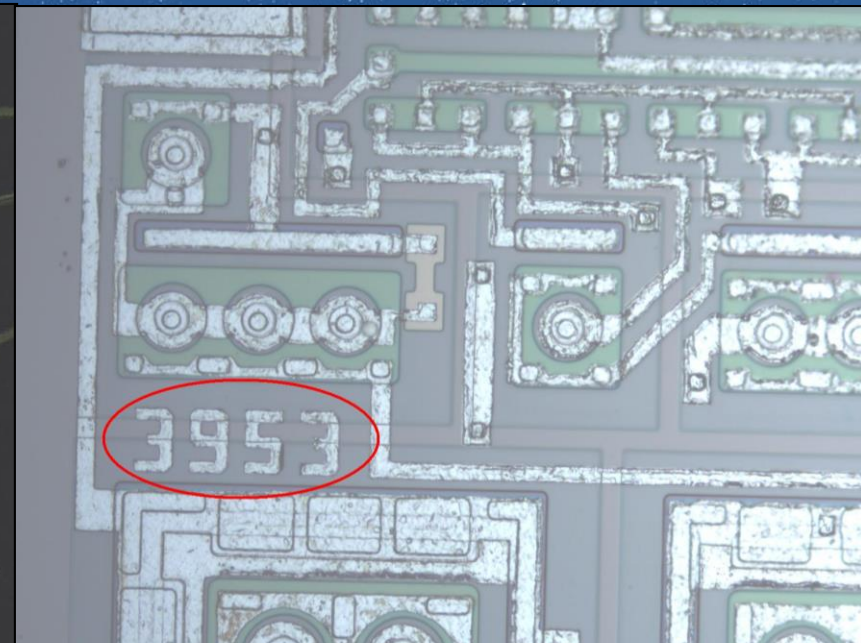
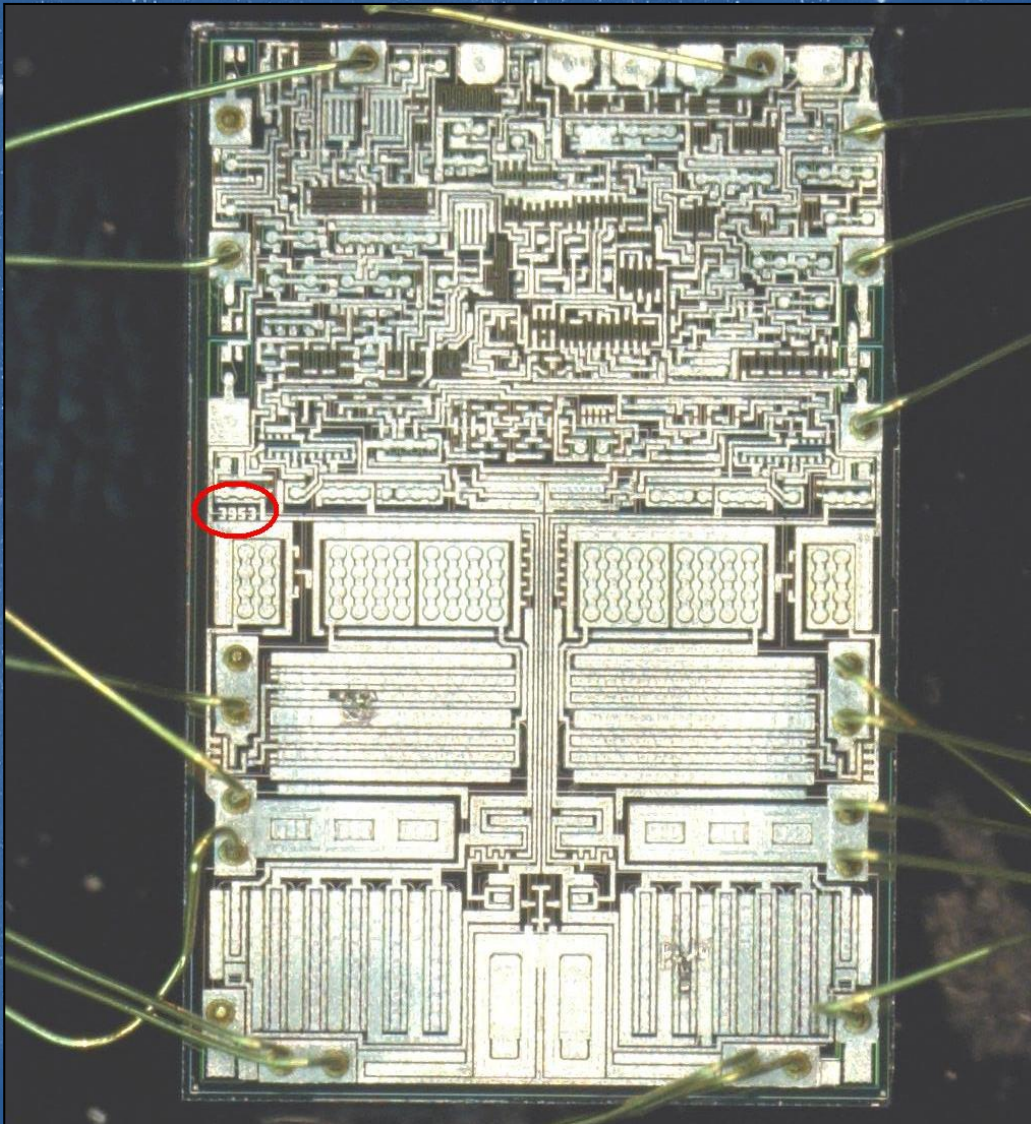
Product Lines – EEE Parts (cont.)



Product Lines – EEE Parts (cont.)



Product Lines – EEE Parts (cont.)



Product Lines - Gases



- Sampling level will depends upon usage of gas
 - Breathing: every bottle must be tested
 - Research/Manufacturing: lot acceptance
- Validation testing is combination of individual tests depending on type of gas, state of gas, and use of gas
 - Chemical Analysis – used for all breathing
 - Must adhere to industry standards for purity
 - Dew Point Measurement – used for all compressed gases (not liquefied gas)
 - Particle fallout – used to verify state of gas

Product Lines – Fasteners & Mechanical Parts



- Qualification of supplier follows pre-determined process to evaluate quality system and product lines
- Traceability level required for parts varies based upon application/usage of parts (e.g. fracture critical, structural, etc.)
- Validation testing is pre-determined when parts are manufactured to specifications; custom plans must be developed for non-spec parts
 - Chemical testing
 - Tensile testing
 - Hardness testing

Product Lines – Fasteners & Mechanical Parts

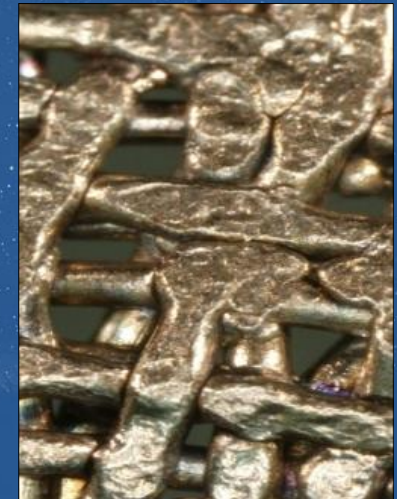


Lot Size	Qualified Supplier		Non-Qualified Supplier		Acceptance Criteria
	Complete Traceability	Incomplete Traceability	Complete Traceability	Incomplete Traceability	
1-2	0	1	2	2	0 failures
3-15	0	2	3	3	0 failures
16-25	0	3	4	4	0 failures
26-50	0	4	5	5	0 failures
51-90	0	5	6	6	0 failures
91-150	0	6	7	7	0 failures
151-280	0	7	10	10	0 failures
281-500	0	9	11	11	0 failures
501-1200	0	11	15	15	0 failures
1201-3200	0	13	18	18	0 failures
3201-10,000	0	15	22	22	0 failures
10,000-35,000	0	15	29	29	0 failures
35,001-150,000	0	15	29	29	0 failures
150,001-500,000	0	15	29	29	0 failures
500,001+	0	15	29	29	0 failures

Product Lines – Fasteners & Mechanical Parts



- NASA Receiving Inspection and Test Facility (RITF) tests lots of fasteners for NASA, contractors, and other corporations
- 2014 – 329 Fastener Jobs
 - 7 rejections – Failed fastener Tensile
 - 2 rejections – Failed fastener Hardness
 - 5 rejections – Failed fastener OES (Chemistry)
- 2015 - 164 Fastener Jobs (YTD)
 - 2 rejections – Failed fastener Tensile
 - 2 rejections – Failed fastener OES (Chemistry)



Product Lines – Raw Materials



- Qualification of supplier follows pre-determined process to evaluate quality system and product lines
- Validation testing is combination of individual tests depending on primary element and sub-category of metal/alloy
 - Chemical testing
 - Tensile testing
 - Hardness testing
 - Conductivity testing
- Validation testing is required, regardless of qualification, when material originates from foreign source



For More Information

<http://fal.jsc.nasa.gov/>